

780 CMR 3604

FOUNDATIONS

780 CMR 3604.1 GENERAL

**3604.1.1 General:** The provisions of 780 CMR 3604.0 shall control the design and construction of the foundation and foundation spaces for all buildings.

**3604.1.2 Requirements:** The foundation and its structural elements shall be capable of accommodating all superimposed live, dead and other loads according to **780 CMR 3603.0** and all lateral loads in accordance with the provisions of 780 CMR 36. Fills which support footings and foundations shall be designed, installed and tested in accordance with accepted engineering practice. Gravel fill used as footings for wood foundations shall comply with **780 CMR 3604.3**.

**3604.1.3 Drainage:** Surface drainage shall be diverted to a storm sewer conveyance or other point of collection or *away from the foundation system* to *avoid* creating a hazard. *Finished grades shall be arranged to direct* surface water away from *all* foundation walls. The *finished* grade shall *slope a minimum of 1/2" per foot for a distance of at least six feet from the face of all foundation walls*.

**Exception:** Where lot lines, walls, slopes or other physical barriers *interfere with the drainage requirements of 780 CMR 3604.1.3*, drains or swales shall be provided to ensure *that surface drainage is appropriately diverted* away from the structure.

**3604.1.4 Geotechnical evaluation:** The *presumptive* load-bearing values *defined* in Table 3604.1.4 shall be *used to determine soil bearing capacity for all foundation systems defined herein*.

**Exception:** *Where there is evidence that expansive, compressible, shifting or other unstable soil characteristics exist*, the building official shall require soil tests as *necessary* to determine the *bearing capacity of the soil*. *For the purposes of this section, soils test shall be conducted in accordance with 780 CMR 1802.0*.

**3604.1.5 Expansive, compressible or shifting soil:** When top or subsoils are expansive, compressible or shifting, such soils shall be removed to a depth and width sufficient to assure stable moisture content in each active zone and shall not be used as fill; or stabilized within each active zone by chemical, dewatering or presaturation.

TABLE 3604.1.4  
PRESUMPTIVE LOAD-BEARING VALUES  
OF FOUNDATION MATERIALS

CLASS OF MATERIAL	LOAD BEARING PRESSURE (pounds per square foot)
Crystalline bedrock	12,000
Sedimentary rock	6,000
Sandy gravel or gravel	5,000
Sand, silty sand, clayey sand, silty gravel and clayey gravel	3,000
Clay, sandy clay, silty clay, and clayey silt	2,000

780 CMR 3604.2 MATERIALS

**3604.2.1 Wood foundations:** Wood foundation systems shall be designed and installed in accordance with the provisions **780 CMR 36**.

**Exception:** The provisions of 780 CMR 3604.2 for wood foundations apply only in the following situations:

- 1. Buildings supported by wood foundations shall be limited to no more than two floors and a roof.
- 2. No dimension in a basement room or crawl space area shall exceed the smaller *dimension* of either the building width or *building* length.

**3604.2.1.1 Fasteners:** Fasteners used below grade to attach plywood to the exterior side of exterior basement or crawlspace wall studs, or fasteners used in knee wall construction, shall be of Type 304 or 316 stainless steel. Fasteners used above grade to attach plywood, and all lumber-to-lumber fasteners except those used in knee wall construction shall be of Type 304 or 316 stainless steel, silicon bronze, copper, hot-dipped galvanized (zinc coated) steel nails, or hot-tumbled galvanized (zinc coated) steel nails. Electrogalvanized steel nails and galvanized (zinc coated) steel staples shall not be permitted.

**3604.2.1.2 Wood treatment:** All lumber and plywood shall be treated in accordance with AWPAC22 *as listed in Appendix A* and shall be identified as in conformance with such standard by an approved inspection agency. Where lumber and plywood is cut or drilled after treatment, the cut surface shall be field treated with Ammoniacal Copper Arsenate (ACA), Chromated Copper

THE MASSACHUSETTS STATE BUILDING CODE

Arsenate (CCA), or Copper Napthenate by repeated brushing, dipping or soaking until the wood absorbs no more preservative. Water-borne preservatives ACA and CCA Types A, B and C

ONE AND TWO FAMILY DWELLINGS - FOUNDATIONS

shall have a minimum concentration of 3% in solution. Water-borne preservatives FCAP and ACC shall be permitted for field treatment of material originally treated with CCA and ACA water-borne preservatives, and the concentration of FCAP or ACC shall be a minimum of 5% in solution. Copper Napthenate shall be prepared with a solvent conforming to AWWA P5. The preservative concentration shall contain a minimum of 2% copper metal.

**3604.2.2 Concrete:** Concrete shall have a minimum specified compressive strength as shown in Table 3604.2.2 and shall be air entrained when subject to freezing and thawing during construction. Total air content (percent by volume of concrete) shall not be less than 5% or more than 7%.

**Exception:** Concrete mixtures *used* for exterior porches, carport slabs, and steps that will be exposed to freezing and thawing in the presence of deicing chemicals shall *consist of* 520 pounds (236 kg) of cement per cubic yard of concrete *which* meets ASTM C 150 or C 595 as listed in Appendix A.

TABLE 3604.2.2  
MINIMUM SPECIFIED COMPRESSIVE  
STRENGTH OF CONCRETE

TYPE OR LOCATION OF CONCRETE CONSTRUCTION	MINIMUM SPECIFIED COMPRESSIVE STRENGTH <sup>1</sup> ( <i>f'</i> <sub>c</sub> )
Basement walls and foundations not exposed to the weather	2,500 <sup>2</sup>
Basement slabs and interior slabs on grade, except garage floor slabs	2,500 <sup>2</sup>
Basement walls, foundation walls, exterior walls and other vertical concrete work exposed to the weather	3,000 <sup>3</sup>
Porches, carport slabs and steps exposed to the weather, and garage floor slabs	3,500 <sup>3,4</sup>

For SI: 1 psi = 6.895 kPa.

- 1. At 28 days psi.
- 2. Concrete in these locations which may be subject to freezing and thawing during construction shall be air-entrained concrete in accordance with Footnote 3.
- 3. Concrete shall be air-entrained. Total air content (percent by volume of concrete) shall not be less than 5% or more than 7%.
- 4. See 780 CMR 3604.2.2. for minimum cement content.

780 CMR 3604.3 FOOTINGS

**3604.3.1 General:** All *permanent supports of buildings and structures larger than 120 square feet in area or ten feet in height shall extend to minimum of four feet (1.2 m) below finished grade* except when erected on solid rock or otherwise

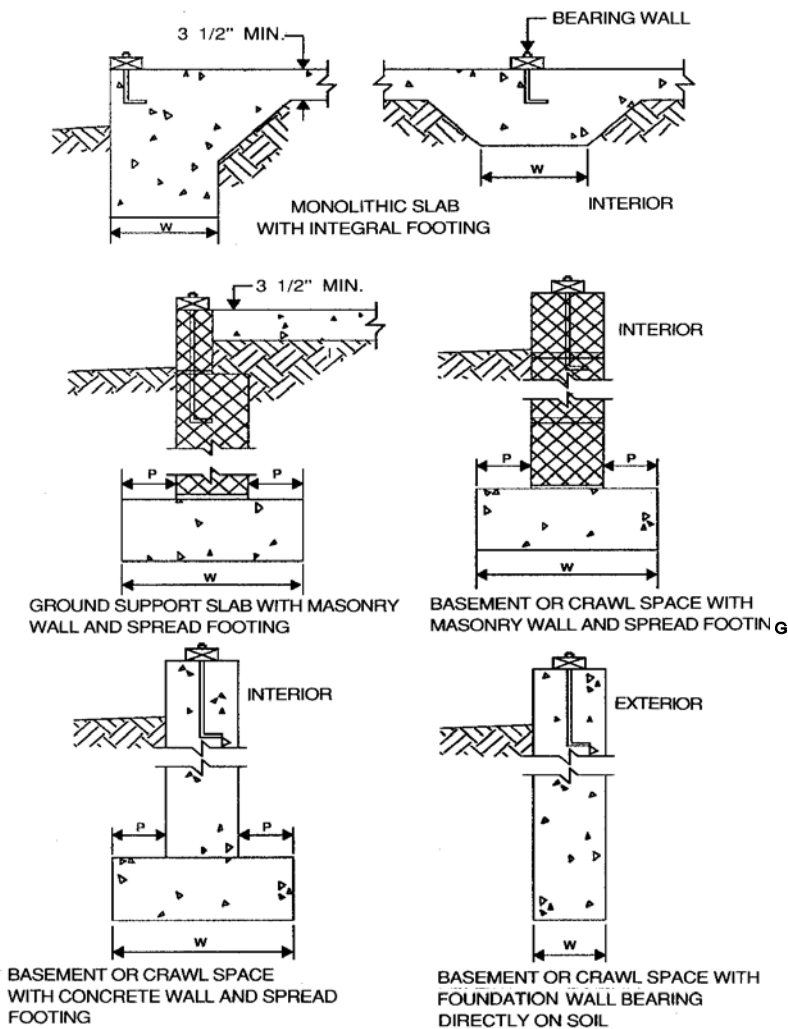
protected from frost, *or when the foundation grade is established by a registered design professional and is approved by the building code official.* Minimum sizes for concrete or masonry footings shall be as set forth in Table 3604.3.1 and Figure 3604.3.1a.

**3604.3.1.1 Slope:** The top surface of *all* footings shall be level. The bottom surface of footings may have a slope not exceeding one unit vertical in ten units horizontal (10% slope). Footings shall be stepped where it is necessary to change the elevation of the top surface of the footing, or where the slope of the bottom surface of the footing will exceed one unit vertical in ten units horizontal (10% slope).

**3604.3.2 Footings for wood foundations:** Footings for wood foundations shall *comply* with the *applicable provisions of 780 CMR 3604.4, and Figures 3604.3.1b and 3604.3.1c. The gravel base depicted in Figures 3604.3.1b and 3604.3.1c* shall be washed and well graded. The maximum size stone shall not exceed ¾ inch (19 mm). Gravel shall be free from organic, clayey or silty soils. Sand shall be coarse, not smaller than 1/16-inch (1.6 mm) grains and shall be free from organic, clayey or silty soils. Crushed stone shall have a maximum size of ½ inch (12.7 mm).

**3604.3.3 Insulated footings:** Footings for heated buildings with slab-on-ground foundations are not required to extend below the frost line when protected from frost by insulating *methods prescribed by* Figure 3604.3.3a and Table 3604.3.3. Materials used below grade for the purpose of insulating foundations against frost shall be labeled as complying with ASTM C 578.

**FIGURE 3604.3.1a**  
**CONCRETE AND MASONRY**  
**FOUNDATION DETAILS**

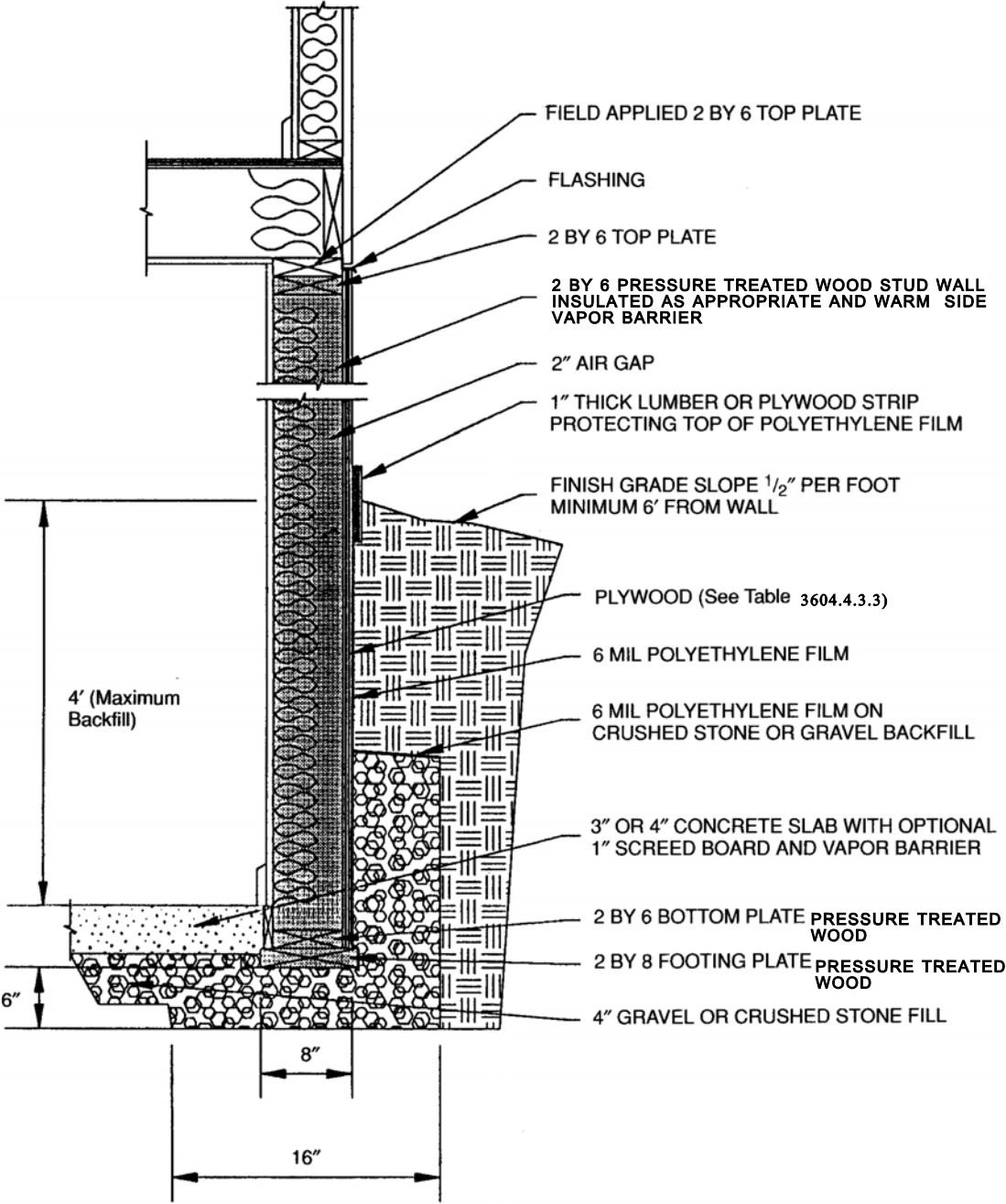


For SI 1 inch = 25.4 mm, 1 foot = 304.8 mm.

**NOTES:**

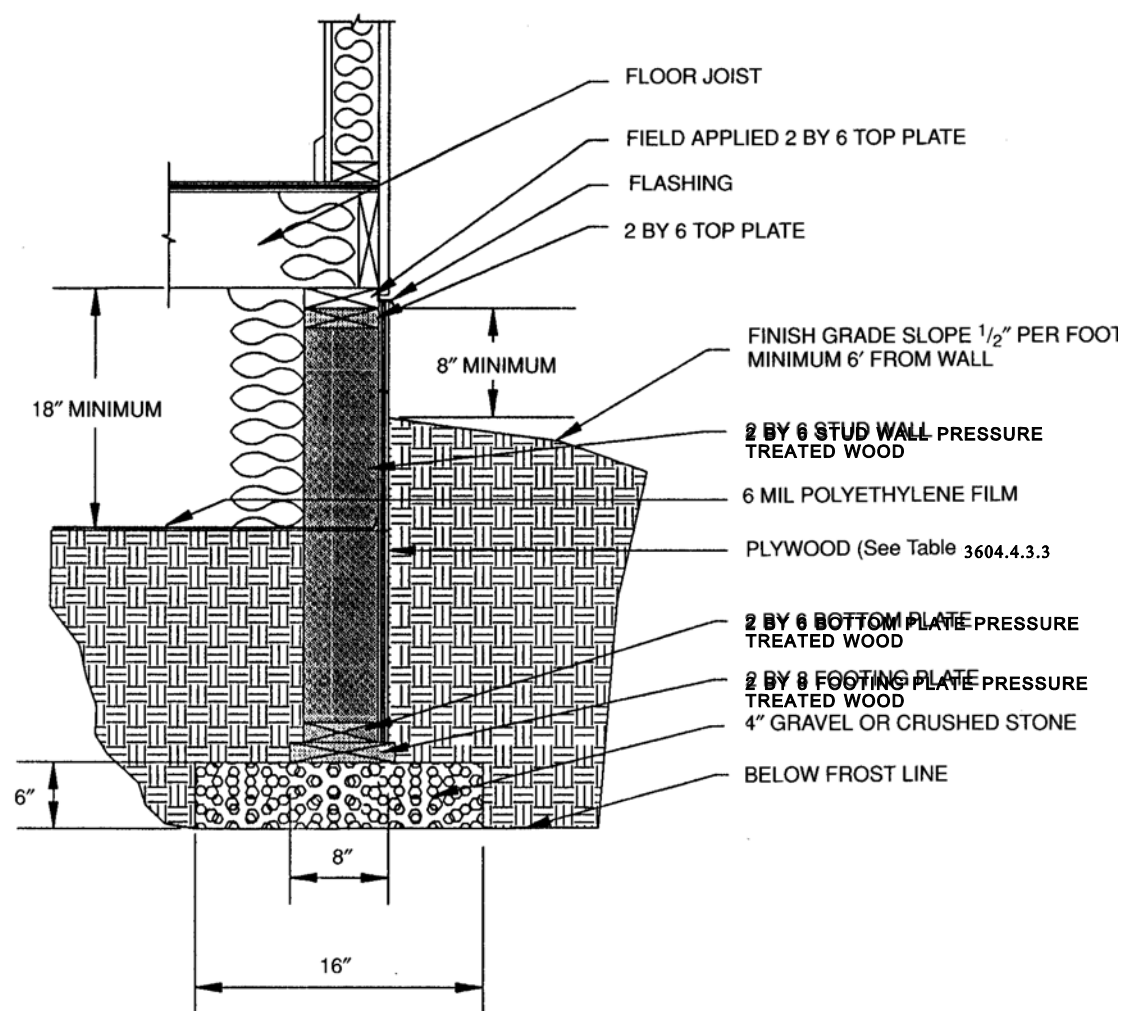
1. Exterior footings shall extend to below the frost line unless otherwise protected against frost heave. In no case shall exterior footings be less than 12 inches below grade.
2. Footing widths (*W*) shall be based on the load-bearing value of the soil in accordance with Table 3604.1.4 or shall be designed in accordance with accepted engineering practice.
3. Spread footings shall be a minimum of six inches thick, and footing projections (*P*) shall be a minimum two inches and shall not exceed the footing thickness.
4. Footings shall be supported on undisturbed natural soil or engineered fill.
5. The sill plate or floor system shall be anchored to the foundation with ½-inch-diameter bolts placed six feet on center and not more than 12 inches from corners. Bolts shall extend a minimum of 15 inches into masonry or eight inches into concrete. Sill plates shall be protected against decay where required by 780 CMR 3603.22. See also 780 CMR 3604.10
6. Pier and column footing sizes shall be based on the tributary load and allowable soil pressure in accordance with Table 3605.2.3.3b.

**FIGURE 3604.3.1b**  
**TYPICAL DETAILS FOR WOOD FOUNDATION BASEMENT WALL**



For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

FIGURE 3604.3.1c  
TYPICAL DETAILS FOR WOOD FOUNDATION CRAWL SPACE WALLS



For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

TABLE 3604.3.1  
MINIMUM WIDTH OF CONCRETE OR  
MASONRY FOOTINGS (inches)

	LOAD-BEARING VALUE OF SOIL (psf)					
	1,500	2,000	2,500	3,000	3,500	4,000
Conventional Wood Frame Construction						
1-story	16	12	10	8	7	6
2-story	19	15	12	10	8	7
3-story	22	17	14	11	10	9
4-inch Brick Veneer over Wood Frame or 8-inch Hollow Concrete Masonry						
1-story	19	15	12	10	8	7
2-story	25	19	15	13	11	10
3-story	31	23	19	16	13	12
8-inch Solid or Fully Grouted Masonry						
1-story	22	17	13	11	10	9
2-story	31	23	19	16	13	12
3-story	40	30	24	20	17	15

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

TABLE 3604.3.3  
MINIMUM INSULATION REQUIREMENTS  
FOR FROST-PROTECTED FOOTINGS IN  
HEATED BUILDINGS

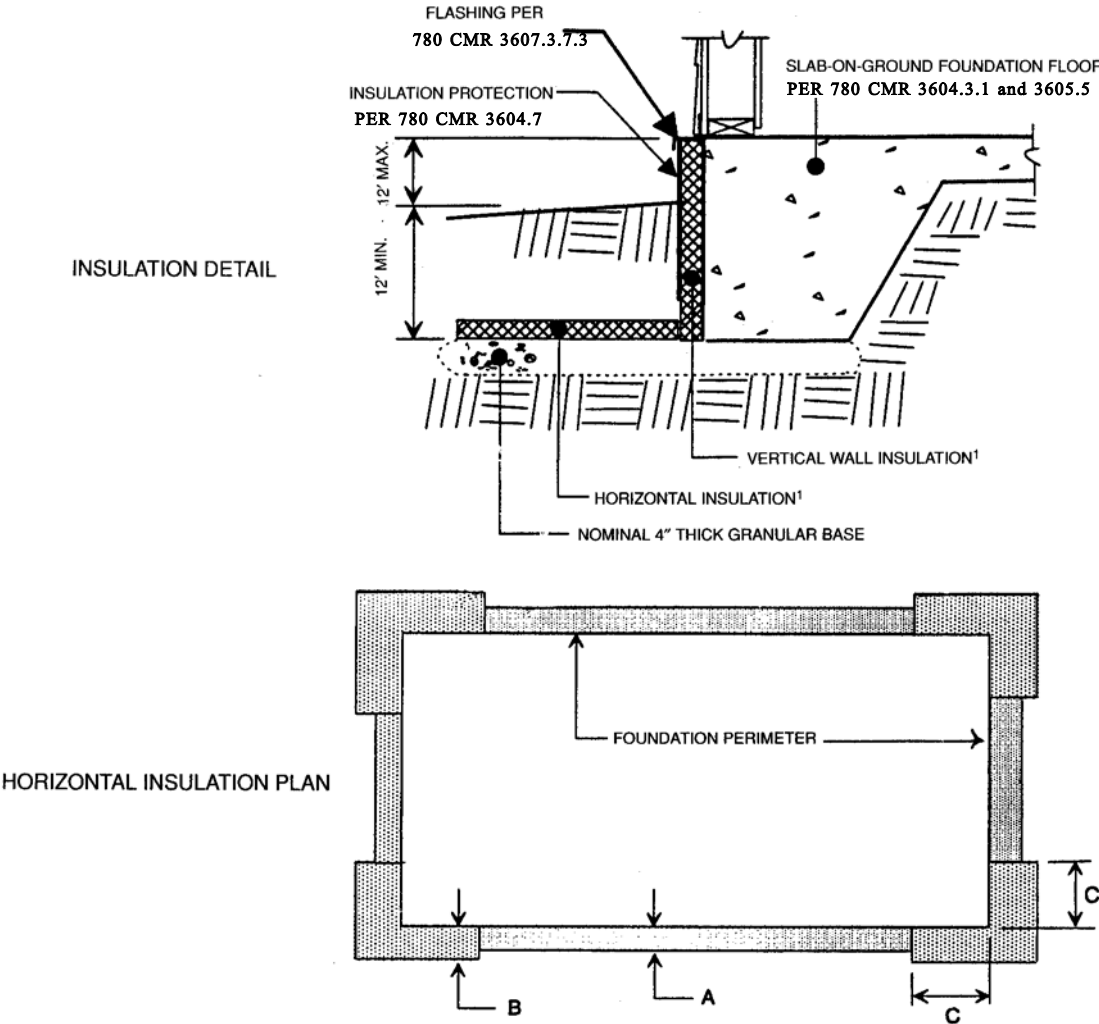
VERTICAL INSULA- TION R- VALUE <sup>2,4</sup>	HORIZONTAL INSULATION R- VALUE <sup>3,5</sup>		HORIZONTAL INSULATION DIMENSIONS PER FIGURE 3604.3.3 (inches)		
	along walls	at corners	A	B	C
4.5	NR	NR	NR	NR	NR

For SI: 1 inch = 25.4 mm, °F = 1.8°C + 32

- Insulation requirements are for protection against frost damage in heated buildings. Greater values may be required to meet energy conservation standards. Interpolation between values is permissible.
- Air Freezing Index values based on 1,500 °F days.
- Insulation materials shall provide the stated minimum R-values under the long term exposure to moist, below-ground conditions in freezing climates. The following R-values shall be used to determine insulation thickness required for this application: Type II expanded polystyrene - 2.4R per inch; Type IV extruded polystyrene - 4.5R per inch; Type VI extruded polystyrene - 4.5R per inch; Type IX expanded polystyrene - 3.2R per inch; Type X extruded polystyrene - 4.5R per inch. NR indicates that insulation is not required.
- Vertical insulation shall be expanded polystyrene insulation or extruded insulation.

5. Horizontal insulation shall be extruded polystyrene insulation.

**FIGURE 3604.3.3a**  
**INSULATION PLACEMENT FOR FROST-PROTECTED FOOTINGS**  
**IN HEATED BUILDINGS**



For SI: 1 inch = 25.4 mm.

1. See table 3604.3.3 for required dimensions and R-values for vertical and horizontal insulation.

**780 CMR 3604.4 FOUNDATION WALLS**

**3604.4.1 Concrete and masonry foundation walls:** Foundation walls shall be constructed in accordance with the provisions of 780 CMR 3604.4 or in accordance with ACI 318, ACI 318.1, NCMA TR68-A or ACI 530/ASCE 5/TMS 402 *as listed in Appendix A*, or other approved structural systems.

**3604.4.1.1 Masonry and concrete wall construction:** Masonry and concrete foundation walls shall be constructed as *in accordance with Table 3604.4.1.1a*.

**Exception:** Where unstable soil conditions exist or where the foundation extends to or below the seasonal high groundwater table, foundation walls shall be constructed in accordance with Table *3604.4.1.1b*.

**3604.4.1.2 Design:** Foundation walls subject to more pressure than would be exerted by backfill having an equivalent fluid weight of 30 pounds per cubic foot (141 kN/m<sup>3</sup>) shall be designed in

accordance with accepted engineering practice by a registered professional engineer or registered architect.

**3604.4.1.3 Grade Clearance:** Foundation walls shall extend at least *eight inches* above the finished grade adjacent to the foundation at all points.

**Exception:** Where masonry veneer is used, foundation walls shall extend a minimum of four inches (102 mm) above the finished grade.

**TABLE 3604.4.1.1a**  
**MINIMUM THICKNESS AND ALLOWABLE**  
**DEPTH OF UNBALANCED FILL FOR**  
**UNREINFORCED MASONRY AND**  
**CONCRETE FOUNDATION WALLS<sup>1,2</sup>**  
**WHERE UNSTABLE SOIL OR**  
**GROUNDWATER CONDITIONS DO NOT**  
**EXIST**

FOUNDATION WALL CONSTRUCTION	NOMINAL THICKNESS <sup>3</sup> (inches)	MAXIMUM DEPTH OF UNBALANCE D  <sup>1</sup> FILL (feet)
Masonry of Hollow Units, UngROUTed	8	4
	10	5
	12	6
Masonry of Solid Units	6	3
	8	5
	10	6
	12	7
Masonry of Hollow or Solid Units, Fully Grouted	8	7
	10	8
	12	8
Plain Concrete	6 <sup>4</sup>	6
	8	7
	10	8
	12	8
Rubble Stone Masonry	16	8
Masonry of hollow units	8	7

**TABLE 3604.4.1.1 b**  
**REQUIREMENTS FOR MASONRY OR CONCRETE FOUNDATION WALLS SUBJECTED TO**  
**NO MORE PRESSURE THAN WOULD BE EXERTED BY BACKFILL HAVING AN**  
**EQUIVALENT FLUID WEIGHT OF 30 POUNDS PER CUBIC FOOT OR SUBJECTED TO**  
**UNSTABLE SOIL CONDITIONS**

reinforced vertically, with No. 4 bars and grout at 24 inches on center. Bars located not less than 4½ inches from pressure side of wall.		
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For SI: 1 inch = 25.4 mm; 1 foot = 304.8 mm.

1. Unbalanced fill is the difference in height of the exterior and interior finish ground levels. Where an interior concrete slab is provided, the unbalanced fill shall be measured from the exterior finish ground level to the top of the interior concrete slab.

2. The height between lateral supports shall not exceed eight feet.

3. The actual thickness shall not be more than ½ inch less than the required nominal thickness specified in the table.

4. Six-inch plain concrete walls shall be formed on both sides.



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ONE AND TWO FAMILY DWELLINGS - FOUNDATIONS

MATERIAL TYPE	HEIGHT OF UNBALANCED FILL IN FEET <sup>1</sup>	LENGTH OF WALL BETWEEN SUPPORTING MASONRY OR CONCRETE WALLS IN FEET	MINIMUM <sup>2</sup> WALL THICKNESS IN INCHES <sup>3</sup>	REQUIRED REINFORCING	
				Horizontal Bar in Upper 12 inches of wall	Size and Spacing of Vertical Bars
Hollow Masonry	4 or less	unlimited	8	not required	not required
	more than 4	design required	design required	design required	design required
Concrete or Solid Masonry <sup>4</sup>	4 or less	unlimited	8	noot required	not required
	more than 4	less tha 8	8	2-No. 3	No. 3 @ 18" o.c.
	8 or less	8 to 10	8	2-No. 4	No. 3 @ 18" o.c.
	8 or less	10 to 12	8	2-No. 5	No. 3 @ 18" o.c.
	more than 8	design required	design required	design required	design required

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per cubic foot (pcf) = 0.1572 kN/m<sup>3</sup>.

1 Backfilling shall not be commenced until after the wall is anchored to the floor or adequate bracing is in place.

2. Thickness of concrete walls may be six inches, provided reinforcing is placed not less than one inch or more than two inches from the face of the wall not against the earth.

3. The actual thickness shall not be more than ½ inch less than the required thickness specified in the table.

4. Solid masonry shall include solid brick or concrete units and hollow masonry units with all cells grouted.

**3604.4.1.3.1 Backfill placement:** Backfill adjacent to the wall shall not be placed until the wall has sufficient strength *in accordance with 780 CMR 3604.2.2* and has been anchored to the floor, or has been sufficiently braced to prevent damage by the backfill.

**Exception:** Such bracing is not required for walls *retaining* less than three feet (914 mm) of unbalanced backfill.

**3604.4.3 Wood foundation walls:** Wood foundation walls shall be constructed in accordance with the provisions of *780 CMR 3604.4.3.1* through *3604.4.3.5* and with the details shown in Figures *3604.3.1b* and *3604.3.1c*.

**3604.4.2 Design required:** Foundation walls subject to more lateral pressure than would be exerted by backfill consisting of freely draining sands and gravel classified as Group I according to the United States Soil Classification System or soils having an equivalent fluid weight of greater than 30 pounds per cubic foot (4.72 kN/m<sup>3</sup>) shall be designed in accordance with accepted engineering practices by a registered professional engineer or registered architect.

**3604.4.3.1 Wood grade:** All load-bearing lumber and plywood shall conform to applicable standards or grading rules and be identified by a grade mark or certificate of inspection issued by an approved lumber or plywood grading or inspection bureau or agency. Lumber shall conform to DOC PS 20-94.

TABLE 3604.4.3.3  
PLYWOOD GRADE AND THICKNESS FOR  
WOOD FOUNDATION CONSTRUCTION  
(30 pcf equivalent-fluid weight soil pressure)

HEIGH T OF FILL (inches)	STUD SPACING (inches)	FACE GRAIN ACROSS STUDS			FACE GRAIN PARALLEL TO STUDS		
		Grade <sup>1</sup>	Minimum Thickness	Identification Index	Grade <sup>1</sup>	Minimum Thickness <sup>2,3</sup>	Identification Index
24	12	B	15/32	32/16	A	15/32	32/16
					B	15/32 <sup>3</sup>	32/16
	16	B	15/32	32/16	A	15/32 <sup>3</sup>	32/16
					B	19/32 <sup>3</sup> (4,5 ply)	40/20
36	12	B	15/32	32/16	A	15/32	32/16
					B	15/32 <sup>3</sup> (4,5 ply)	32/16
	16	B	15/32	32/16	B	19/32 (4, 5 ply)	40/20
					A	19/32	40/20

					B	23/32	48/24
					A	15/32 <sup>3</sup>	32/16
	12	B	15/32	32/16	B	19/32 <sup>3</sup> (4, 5 ply)	40/20
					A	19/32 <sup>3</sup>	40/20
48	16	B	19/32	40/20	A	23/32	48/24

- For SI: 1 inch = 25.4 mm, 1 pound per cubic foot = 0.1572 kN/m<sup>3</sup>.
- Plywood shall be of the following minimum grades in accordance with DOC PS1 or DOC PS2:
    - DOC PS 1 Plywood grades marked:
      - Structural I C-D (Exposure 1)
      - C-D (Exposure 1)
    - DOC PS 2 Plywood grades marked:
      - Structural I Sheathing (Exposure 1)
      - Sheathing (Exposure 1)
    - Where a major portion of the wall is exposed above ground and a better appearance is desired, the following plywood grades marked Exterior are suitable:
      - Structural I A-C, Structural I B-C or Structural I C-C (Plugged) in accordance with DOC PS 1
      - A-C Group 1, B-C Group 1, C-C (Plugged) Group 1 or MDO Group 1 in accordance with DOC PS 1
      - Single Floor in accordance with DOC PS 2
  - Minimum thickness 15/32 inch, except crawl space sheathing may be \_ inch for face grain across studs 16 inches on center and maximum two foot depth of unequal fill.
  - For this fill height, thickness and grade combination, panels which are continuous over less stud spacings require blocking 16 inches above the bottom plate. Offset adjacent blocks and fasten through corrosion-resistant nails at each end.

**3604.4.3.2 Stud size:** The studs used in foundation walls shall be two by six (51 by 153) members. When spaced 16 inches on center, a wood species with an F<sub>b</sub> value of not less than 1,250 psi (8612 kPa) as listed in

**3604.4.3.3 Height of backfill:** The height of backfill against a foundation wall shall not exceed four feet (1219 mm). When the height of fill is more than 12 inches (305 mm) above the interior grade of a crawl space or floor of a basement, the thickness of the plywood sheathing shall meet the requirements of Table **3604.4.3.3**.

**3604.4.3.4 Backfilling:** Wood foundation walls shall not be backfilled until the basement floor and first floor have been constructed or the walls have been braced. For crawl space construction, backfill or bracing shall be installed on the interior of the walls prior to placing backfill on the exterior.

**3604.4.3.5 Drainage and dampproofing:** Wood foundation basements shall be drained and dampproofed in accordance with 780 CMR 3604.5 and 780 CMR 3604.6, respectively.

**780 CMR 3604.5 FOUNDATION DRAINAGE**

**3604.5.1 Concrete or masonry foundations:** Drains shall be provided around all concrete or masonry foundations enclosing habitable or usable spaces located below grade. Drainage tiles, gravel or

Table **3605.2.3.1d** shall be used. When spaced 12 inches (305 mm) on center, an F<sub>b</sub> of not less than 875 (6029 kPa) shall be required.

crushed stone drains, perforated pipe or other approved systems or materials shall be installed at or below the area to be protected and shall discharge by gravity or mechanical means into an approved drainage system. Gravel or crushed stone drains shall extend at least one foot (305 mm) beyond the outside edge of the footing and six inches (153 mm) above the top of the footing and be covered with an approved filter membrane material. The top of open joints of drain tiles shall be protected with strips of building paper, and the drainage tiles or perforated pipe shall be placed on a minimum of two inches (51 mm) of washed gravel or crushed rock at least one sieve size larger than the tile joint opening or perforation and covered with not less than six inches (153 mm) of the same material.

**Exception:** A drainage system is not required when the foundation is installed on well-drained ground or sand-gravel mixture soils according to the Unified Soil Classification System, Group I Soils, as detailed Table **3604.5.1**.

**TABLE 3604.5.1  
PROPERTIES OF SOILS CLASSIFIED ACCORDING TO THE UNIFIED  
SOIL CLASSIFICATION SYSTEM**

ONE AND TWO FAMILY DWELLINGS - FOUNDATIONS

SOIL GROUP	UNIFIED SOIL CALSSIFICATION SYSTEM SYMBOL	SOIL DESCRIPTION	DRAINAGE CHARACTERISTICS <sup>1</sup>	FROST HEAVE POTENTIAL	VOLUME CHANGE POTENTIAL EXPANSION
Group I	GW	Well-graded gravels, gravel sand mixtures, little or no fines	Good	Low	Low
	GP	Poorly graded gravels or gravel sand mixtures, little or no fines	Good	Low	Low
	SW	Well-graded sands, gravelly sands, little or no fines	Good	Low	Low
	SP	Poorly graded sands or gravelly sands, little or no fines	Good	Low	Low
	GM	Silty gravels, gravel-sand-silt mixtures	Good	Medium	Low
	SM	Silty sand, sand-silt mixtures	Good	Medium	Low
Group II	GC	Clayey gravels, gravel-sand-clay mixtures	Medium	Medium	Low
	SC	Clayey sands, sand-clay mixture	Medium	Medium	Low
	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.	Medium	High	Low
	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	Medium	Medium	Medium <sup>2</sup> to Low
Group III	CH	Inorganic clays or high plasticity, fat clays	Poor	Medium	High <sup>2</sup>
	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	Poor	High	High
Group IV	OL	Organic silts and organic silty clays of low plasticity.	Poor	Medium	Medium
	OH	Organic clays of medium to high plasticity, organic silts.	Unsatisfactory	Medium	High
	Pt	Peat and other highly organic soils	Unsatisfactory	Medium	

## THE MASSACHUSETTS STATE BUILDING CODE

For SI: 1 inch = 25.4 mm.

- 1 The percolation rate for good drainage is over four inches per hour, medium drainage is two to four inches per hour, and poor is less than two inches per hour.
2. Dangerous expansion might occur if these two soil types are dry but subject to future wetting.

**3604.5.2 Wood foundations:** Wood foundations enclosing habitable or usable spaces located below grade shall be adequately drained in accordance with **780 CMR 3604.5.2.1** through **3604.5.2.3**.

**3604.5.2.1 Base:** A porous layer of gravel, crushed stone or coarse sand shall be placed to a minimum thickness of four inches (102 mm) under the basement floor. Provision shall be made for automatic draining of this layer and the gravel or crushed stone wall footings.

**3604.5.2.2 Moisture barrier:** A six-mil-thick (0.15 mm) polyethylene moisture barrier shall be applied over the porous layer with the basement floor constructed over the polyethylene.

**3604.5.2.3 Drainage system:** In other than Group I soils, a sump shall be provided to drain the porous layer and footings. The sump shall be at least 24 inches (610 mm) in diameter or 20 inches square (0.0129 m<sup>2</sup>), shall extend at least 24 inches (610 mm) below the bottom of the basement floor and shall be capable of positive gravity or mechanical drainage to remove any accumulated water. The drainage system shall discharge into an approved sewer system or to daylight.

## 780 CMR 3604.6 FOUNDATION WATERPROOFING AND DAMPPROOFING

**3604.6.1 Concrete and masonry foundation dampproofing:** Except where required to be waterproofed by **780 CMR 3604.6.2**, foundation walls enclosing habitable or storage space shall be dampproofed from the top of the footing to the finished grade. Masonry walls shall be dampproofed by applying not less than  $\frac{1}{8}$  inch (9.5 mm) portland cement parging to the exterior of the wall. The parging shall be covered with a bituminous coating, three pounds per square yard (1.63 kg/m<sup>2</sup>) of acrylic modified cement,  $\frac{1}{8}$ -inch (3.2 mm) coat of surface-bonding mortar complying with ASTM C 887 or any material permitted for waterproofing in **780 CMR 3604.6.2**. Concrete walls shall be dampproofed by applying any one of the above listed dampproofing materials or any one of the waterproofing materials listed in **780 CMR 3604.6.2** to the exterior of the wall.

**3604.6.2 Concrete and masonry foundation waterproofing:** In areas where a high water table or other severe soil-water conditions are known to exist, exterior foundation walls enclosing habitable or storage space shall be waterproofed with a membrane extending from the top of the footing to the finished grade. The membrane shall consist of two-ply hot-mopped felts, 55 pound (25 kg) roll roofing, 6-mil (0.15 mm) polyvinyl chloride, six-mil (0.15 mm) polyethylene or 40-mil (1 mm) polymer-modified asphalt. The joints in the membrane shall be lapped and sealed with an adhesive compatible with the waterproofing membrane.

**3604.6.3 Dampproofing for wood foundations:** Wood foundations enclosing habitable or usable spaces located below grade shall be dampproofed in accordance with **780 CMR 3604.6.3.1** through **3604.6.3.5**.

**3604.6.3.1 Panel joint sealed:** Plywood panel joints in the foundation walls shall be sealed full length with a caulking compound capable of producing a moistureproof seal under the conditions of temperature and moisture content at which it will be applied and used.

**3604.6.3.2 Below grade moisture barrier:** A six-mil-thick (0.15 mm) polyethylene film shall be applied over the below-grade portion of exterior foundation walls prior to backfilling. Joints in the polyethylene film shall be lapped six inches (153 mm) and sealed with adhesive. The top edge of the polyethylene film shall be bonded to the sheathing to form a seal. Film areas at grade level shall be protected from mechanical damage and exposure by a pressure preservatively treated lumber or plywood strip attached to the wall several inches above finish grade level and extending approximately nine inches (229 mm) below grade. The joint between the strip and the wall shall be caulked full length prior to fastening the strip to the wall. Other coverings appropriate to the architectural treatment may also be used. The polyethylene film shall extend down to the bottom of the wood footing plate but shall not overlap or extend into the gravel or crushed stone footing.

**3604.6.3.3 Porous fill:** The space between the excavation and the foundation wall shall be backfilled with the same material used for footings, up to a height of one foot (305 mm)

above the footing for well-drained sites, or ½ the total backfill height for poorly drained sites. The porous fill shall be covered with strips of 30-pound (13.6 kg) asphalt paper or

**3604.6.3.4 Backfill:** The remainder of the excavated area shall be backfilled with the same type of soil as was removed during the excavation. The backfill **shall** be placed in six- to eight-inch (153 mm to 203 mm) layers and compacted to consolidate the fill.

**3604.6.3.5 Final grading:** *Finished grades shall conform to 780 CMR 3604.1.3.*

## 780 CMR 3604.7 FOUNDATION INSULATION

**3604.7.1 Protection of exposed foundation insulation:** Foundation walls and the edges of slab-on-ground floors with exterior applied insulation shall have a rigid, opaque and weather-resistant protective covering to prevent the degradation of thermal performance. The protective covering shall cover the exposed insulation and extend to a minimum of six inches (153 mm) below grade.

## 780 CMR 3604.8 COLUMNS

**3604.8.1 Wood column protection:** Wood columns shall be protected against decay as set forth in **780 CMR 3603.22**.

**3604.8.2 Steel column protection:** All surfaces (inside and outside) of steel columns shall be given a shop coat of rust-inhibitive paint, except for corrosion-resistant steel and steel treated with coatings to provide corrosion resistance.

**3604.8.3 Structural requirements:** **All** columns shall be restrained to prevent lateral displacement. Wood columns shall not be less in nominal size than four inches by four inches (102 mm by 102 mm) and steel columns shall not be less than three-inch-diameter (76 mm) standard pipe or approved equivalent.

## 780 CMR 3604.9 CRAWL SPACE

**3604.9.1 Ventilation:** The space between the bottom of the floor joists and the earth under any building (except such space as is occupied by a basement or cellar) shall be provided with **a sufficient number of** ventilation openings through foundation walls or exterior walls. **Such** ventilation openings shall be covered with corrosion-resistant wire mesh, the least dimension **shall not exceed**    inch (3.2 mm). The minimum net area of ventilation openings shall not be less than one square foot for each 150 square feet (0.67 m<sup>2</sup> for each 100 m<sup>2</sup>) of

six-mil (0.15 mm) polyethylene to permit water seepage while avoiding infiltration of fine soils.

crawl space area. One such ventilating opening shall be within three feet (914 mm) of each corner of the building, **and the ventilation openings shall be positioned to provide cross ventilation.**

### Exceptions:

1. The total area of ventilation openings may be reduced to 1/1,500 of the under-floor area where the ground surface is treated with an approved vapor barrier material and one such ventilation opening is within three feet (914 mm) of each corner of said buildings. The vents may have operable louvers.
2. **If design conditions warrants,** ventilation openings may be omitted on one side.
3. Under-floor spaces used as supply plenums for distribution of heated and cooled air shall comply with the requirements of **780 CMR 3621 as applicable.**
4. Ventilation openings may be omitted when continuously operated mechanical ventilation is provided at a rate of 1.0 cfm for each 50 square feet ( 1.02 L/s for each 10 m<sup>2</sup>) of crawl space floor area and ground surface is covered with an approved vapor barrier material.

**3604.9.2 Access:** An access crawl hole 18 inches by 24 inches (457 mm by 610 mm) shall be provided to the under-floor space.

**3604.9.3 Removal of debris:** The under-floor grade shall be cleaned of all vegetation and organic material. All wood forms used for placing concrete shall be removed before a building is occupied or used for any purpose.

**3604.9.4 Finished grade:** The finished grade of under-floor surface may be located at the bottom of the footings; however, where there is evidence that the groundwater table can rise to within six inches (153 mm) of the finished floor at the building perimeter or where there is evidence that the surface water does not readily drain from the building site, the grade in the under-floor space shall be as high as the outside finished grade, unless an approved drainage system is provided.

**3604.10 Foundation anchorage:** Wall sill plates, minimum of two-inch by four-inch members, shall be sized and anchored to foundation walls or piers and at intermediate intervals as required to resist wind uplift. Foundation anchorage shall be provided by the installation of anchor bolts or other approved anchoring

THE MASSACHUSETTS STATE BUILDING CODE

method. Anchor bolts shall be of a minimum diameter of  $\frac{1}{2}$  inch. The bolts shall be embedded in foundations to a depth of not less than eight inches (203 mm) of cast-in-place concrete, and not less than 15 inches (381 mm) in grouted unit masonry. There shall be a minimum of two anchor bolts per section of

plate and anchor bolts shall be placed 12 inches (305 mm) from the end of each section of plate, with intermediate bolts spaced a maximum of six feet (1829 mm) on center for one- and two-story buildings and not more than four feet (1219 mm) on center for buildings over two stories in height.

NON-TEXT PAGE